

Western Atlantic Climate Study II (WACS II)

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Study area: North Atlantic

Ports: WHOI to WHOI (Woods Hole Oceanographic Institution, Woods Hole MA)

Dates: May 19 to June 6, 2014

WACS II has received endorsement from the Surface Ocean Lower Atmosphere Study (SOLAS).

Background

Sea spray aerosol (SSA) impacts the Earth's radiation budget indirectly by altering cloud properties including albedo, lifetime, and extent, and directly by scattering solar radiation. Characterization of the properties of SSA in its freshly emitted state is needed for accurate model calculations of climate impacts. In addition, simultaneous measurements of surface seawater are required to assess the impact of ocean properties on sea spray aerosol and to develop accurate parameterizations of the SSA number production flux for use in regional and global scale models.

WACS II Working Area

The preliminary cruise track is shown in Figure 1. It is designed to allow for the sampling of seawater, freshly emitted SSA, and ambient aerosol in a phytoplankton bloom region of the North Atlantic and through the chlorophyll gradient south into the oligotrophic waters of the Sargasso Sea (Figure 2). Measurements will be made at a series of stations across the high to low chlorophyll gradient and during transits between stations. Sea days will be divided into approximately 12 days on station sampling nascent sea spray aerosol and conducting CTD casts and 7 days of transit sampling atmospheric aerosol.

Core WACS II Objectives

1. ***Characterization of freshly emitted SSA.*** Freshly emitted SSA will be generated with NOAA Pacific Marine Environmental Laboratory's (PMEL) Sea Sweep particle generator (Figure 3). Sea Sweep allows for the generation and sampling of nascent particles without contamination and modification by existing atmospheric particles and gases (Bates et al., *J. Geophys. Res.*, 2012). Properties of the particles to be characterized include chemical composition, size distribution, number concentration, cloud-nucleating ability, light scattering as a function of relative humidity, and light absorption.
2. ***Characterization of surface and column seawater properties.*** Surface seawater properties to be measured include fluorescence (chlorophyll-a), particulate organic carbon (POC), dissolved organic carbon (DOC), dimethylsulfide (DMS), temperature, salinity, bubble surface tension, exopolymer gels, phytoplankton species composition, and nutrients.

3. *Assessment of the impact of surface seawater properties on SSA.* The response of nascent SSA properties (composition, size distribution, cloud-nucleating ability) to changes in ocean biological regime will be determined.

Figure 1. WACS II proposed cruise track. Atmospheric sampling will be conducted during transits between stations and on the return leg to WHOI.

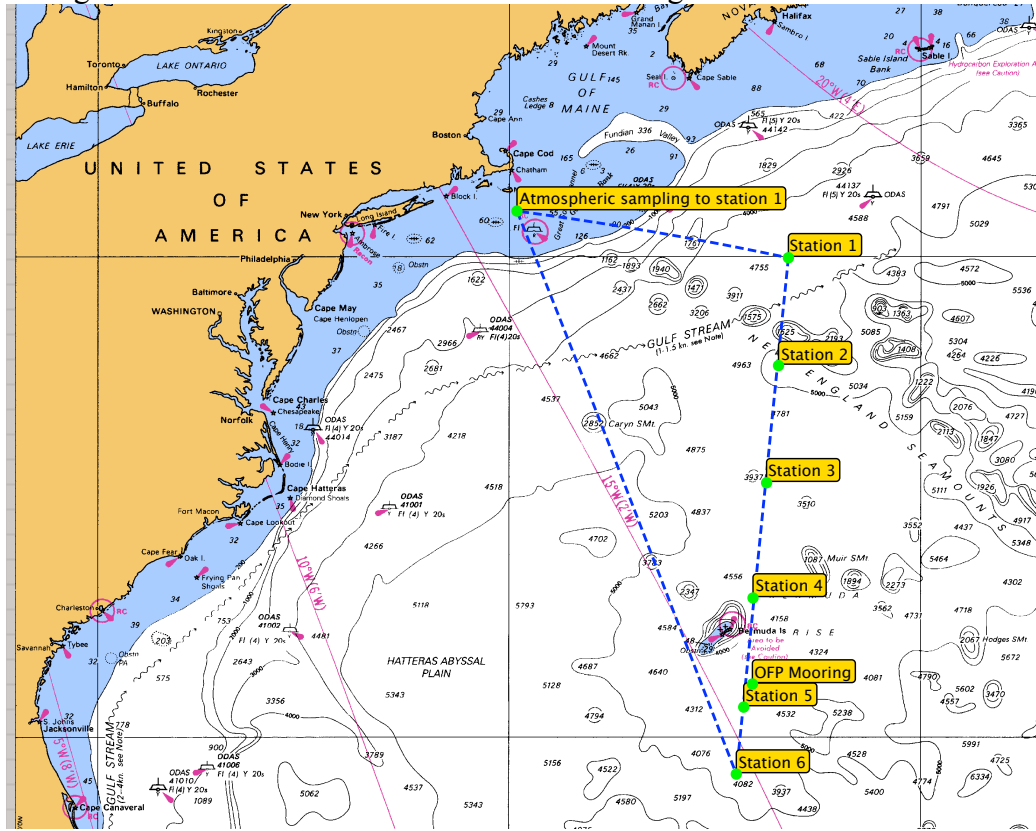


Figure 2. MODIS composite image of ocean color for May 2002 – 2013.

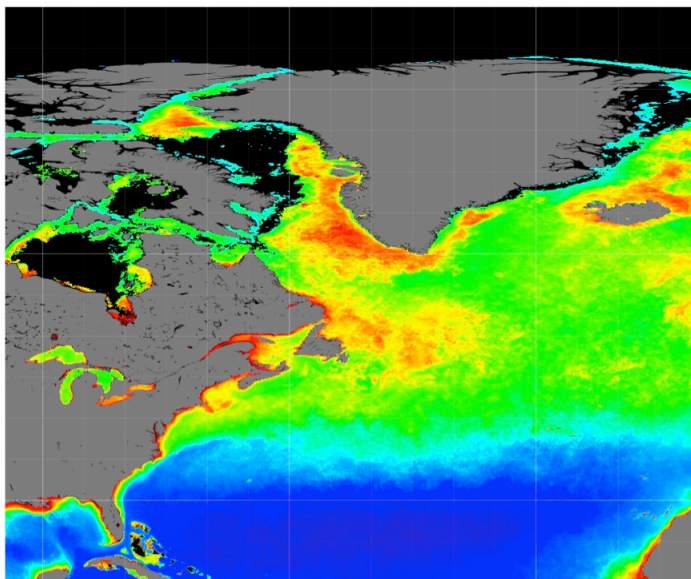


Figure 3. Deployment of Sea Sweep sea spray aerosol generator.



Table 1. Aerosol, gas phase, and seawater measurements.

PI	Institution	Measurements
Aerosol and gas phase measurements		
Quinn	NOAA PMEL	Aerosol chemical, physical, and optical properties
Bertram	UCSD	vertical flux of VOCs by eddy covariance and CIMS
Massoli	Aerodyne	Aerosol composition (SP-AMS)
Orellana	UW	Sea spray aerosol exopolymer gels
Russell	Scripps	Aerosol chemical and physical properties (LS-HR-TOF-AMS, FTIR, DMA, APS, OPS)
Knopf	SUNY	Microscopic single particle analysis, water uptake, and ice nucleation; biosampler for fraction of biological particle
Wozniak	ODU	Aerosol organic matter characterization (proton NMR and MS)
Reid	NRL	Radiosondes, Cielometer, aerosol hygroscopicity
Cappa	UCD	f(RH) of extinction
Seawater measurements		
Bates	NOAA PMEL	Chlorophyll-a, seawater POC and TOC, DMS
Bertram	UCSD	Transfer velocities of VOCs and oVOCs using equilibrator
Orellana	UW	Seawater exopolymer gels
Jennings	RSMAS	DOC precursors, nutrients, DOC, TEP
Aluwihare	UCSD	Surface and depth profiles of DOM; suspended POM to tie lipid signatures to source organisms
Vaillancourt	Millersville	Extracted Chlorophyll-a; photosynthetic efficiency; phytoplankton species composition
Wozniak	ODU	Seawater organic matter characterization (proton NMR and MS)
Gorbunov	Rutgers	Horizontal distributions of plankton physiology in relation to nutrients and aerosol fluxes - satellite validation
Hu	Texas A&M	DIC, alkalinity, pH, d13C of DIC; subdecadal CO2 chemistry changes
Hintz	SSU	Low volume total alkalinity
Long	Harvard	Bubble surface tension